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Chroolepus aureus a lichen

ALBERT SCHNEIDER

(WITH PLATE 22)

During my study of the lichen formations in the vicinity of the Minnesota Seaside Station (near Port Renfrew, Vancouver Island, B. C.), I frequently found *Chroolepus aureus* (L.) Kütz. [*Trentepohlia aurea* (L.) Mart.] on trees (spruce and hemlock) and on rocky ledges overhanging the beach. It is exceedingly abundant in certain circumscribed areas and shows great variability in the length of filaments. There was also observable a marked difference in color, varying largely between that of old gold and a bright orange-brown. As to whether the difference in color indicated two distinct species I will not venture an opinion at present, although the indications are that that is the case. It is very essential that these plants should be studied in the fresh state as they lose the characteristic color very quickly when placed in the herbarium, which increases the difficulties in the way of identification.

The representatives of the genus *Chroolepus* are especially interesting because of their tendency to associate themselves biologically with fungi to form lichens. *Chroolepus umbrinus* (represented in thirteen lichen genera), or a species closely similar to it, forms the algal symbiont of many lichen species. Bearing this in mind, a more careful study was made of *C. aureus*, to determine if this plant presented this character to any marked degree. Fresh material, obtained from ledges of overhanging sandstone and from trunks and branches of hemlocks, was carefully examined under the microscope. The normal filaments showed a variation in length as shown in PLATE 22. The cells contain numerous reddish-brown granules or globules. Very frequently there was found a twining hyphal fungus, especially abundant about the bases of the filaments. This fungus was, however, not sufficiently constant in its appearance to warrant the assumption that it represented a marked biological association with the alga, either antagonistic or mutualistic. More likely it represents merely an accidental association, due to the fact that both organisms live upon the same

substratum and require the same or similar moisture and light conditions.

The interesting feature, however, was a delicately reticulate, spirally wound, network of what appeared to be the hyphal tissue of a fungus which entirely enwrapped the algal threads from base to apex and projected a short distance beyond the apex of most threads. In some instances, this structure extended only to the apex or within a short distance of the tip. This network is very firmly attached to the algal cell-wall. Only after the application of strongly alkaline or strongly acid solutions was it possible to induce it to separate from the algal cells, assisted by pressing the material quite forcibly under the cover-glass. Even then, only fragments could be removed which showed the reticulation very clearly (see plate). The network gives to the filaments a roughened appearance, with here and there a delicate thread (simple or sparingly branched) of the network projecting out from the algal filament. As stated, this mesh-work extends a short distance beyond the apex of the algal thread, in the form of a tube, partially divided across by the same network, thus giving the semblance of partial septation. One, two, or three of these compartments were noticeable, never more. It appears that the compartments are occupied by the new algal cells as the filament grows in length; however, new mesh compartments are always formed in advance of the algal cells.

It would appear that this finely reticulate, colorless network is the hyphal tissue of a fungus which invests the algal filaments, indicating a very intimate biological relationship. It represents a condition not unlike that which exists in the well-known lichen *Ephebe pubescens* Fr., only the fungal symbiont does not penetrate the algal tissue. The hyphal structure of the fungal symbiont in both is closely similar excepting that the anastomoses are much more common in *Chroolepus aureus*. No experiments have been made to determine the biological relationship of the two symbionts, whether antagonistic or mutualistic. Nor was it possible, at the time, to determine conclusively whether or not the fungal symbiont is always present. It was present in all of the material examined, although specimens were found in which the reticulation was rather indistinct. Some authors speak of this terminal

structure as a "cellulose cap," without explaining its nature and use.

There seems to be little doubt that the network described represents a fungus symbiotically associated with the alga *Chroolepus aureus*. This association appears to be sufficiently constant to warrant placing this structure, heretofore classed as an alga, with the class *Lichenes*. The fungal symbiont does not appear to develop spores or any of the other special structures found with the fungal symbionts of the majority of lichens.

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Explanation of plate 22

A, Filaments of *Chroolepus aureus*, showing the enclosing fungal meshwork (a, b) and special algal filaments (c).

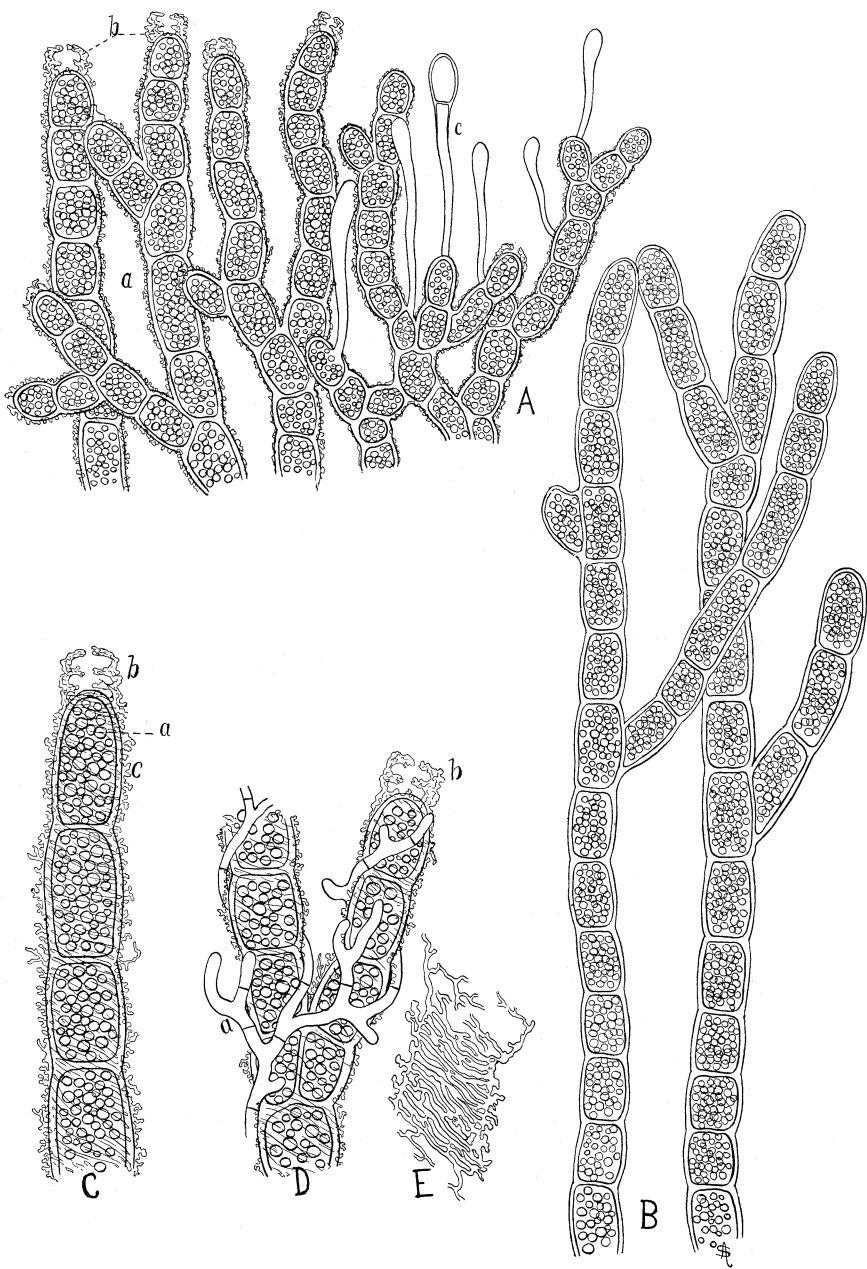
B, Long filaments of *Chroolepus* with the enclosing meshwork removed.

C, Terminal portion of algal filament, more highly magnified. The extreme tip is always free of the fungal symbiont.

D, Basal portion of algal filament, showing the delicate meshwork (b) and the twining filaments of a coarser hyphal fungus (a).

E, A portion of the fungal meshwork removed from the algal filament, showing the characteristic reticulation.

Magnification of *A* and *B* about 225 diameters, of *C*, *D* and *E* about 300 diameters.



CHROOLEPUS AUREUS